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ABSTRACT

Descriptions of about 100 secondary-level activities that can be done on the school grounds are presented. Among the lessons included are a study of life in sidewalk cracks, methods of estimating animal populations, soil testing, constructing and using triangulation instruments to map the school area, and creative writing exercises. Although most activities are science-oriented, many involve mathematics and language arts skills. (WB)

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PINELLAS COUNTY

on campus activity guide

SE 034 032

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ON CAMPUS ACTIVITY GUIDE

1979

The School Board of Pinellas County, Florida

Dr. Gus Sakkis
Superintendent of Schools

John A. Blank
Executive Assistant Superintendent
Division of Curriculum and Instruction

Environmental Education Center
Sawgrass Lake Park

NATURE MEMORY

Take your students outdoors and test their memory powers. Take a short walk around the campus. As you walk along, pick up small objects such as acorns, twigs, berries, etc. Place these items in a paper bag. Do not tell the students why you are placing the items in the bag. At the end of the walk ask the students what things are in the bag. Each student should get one guess. After completing this part of the activity, tell the students that you will repeat the activity. Did the class do better when they knew that they were supposed to remember what was placed in the bag? How many trials did it take before a perfect score was made? Discuss the advantage of note-taking to help people remember things that happen.

THINGS NOT CHANGING

Ask students to identify three items on the school ground which are not changing. After students have compiled a list, discuss results. Ask what their choices will look like in 10 years, 100 years, 1000 years. Emphasize that there is really nothing that is not changing.

ENERGY AND YOUR SENSES

Take students outside and ask them how many ways they can hear energy, see energy, and feel energy. Keep a record of their thoughts. Then discuss which of these things could have been experienced 100 years ago. What would happen if the same questions were asked 100 years into the future?

LIVING INSIDE A LEAF

Ask students to describe in writing what it would be like if they were living inside one of the leaves in the forest. (Incredible journey).

RAINBOWS

When discussing the properties of light and the light spectrum, use the outdoors. Give each group of students a small dish and a mirror. Fill the dish

with water and place it near a wall that is in shadow (the sun and wall should be in the same direction from the dish and the dish should be about 10 to 20 feet away from the wall). Place the mirror at an angle, into the water as deep as the dish will permit. Two images should appear on the wall. The upper one will be a bright white reflection of the sun from the part of the mirror above the water. About 10 feet below this bright image, students should find a rainbow of colors. If students have difficulty in locating the colors, tilt the mirror so that the bright area is higher on the wall and the colors should appear. Adjust the mirror until the colors are brightest. Discuss the properties of white light and the effects of a prism. Try different types of liquids (any transparent liquid). Could this be used to help identify liquids? Discuss "Structural Coloration" in birds - which explains how all blue and green colors in birds are due to the reflection of this spectrum and not true pigment.

WHO'S AFRAID

Have your students conduct a survey of why other students are afraid of spiders, snakes, rats, and bats. Have each group take a different animal on which to report. Discuss the results of the survey. Look for reasons that are similar for each animal. What methods could be used to help people get rid of these fears?

OBSERVATION SKILLS

Walk students to a natural area on campus. Choose any item, such as a tree, flower, a spider in a web, etc. Instruct the class to observe the item for several seconds remembering as much as possible, making a mental picture of the object in their minds. Now turn the class facing away from the object and instruct them to answer a series of questions about what they observed without looking back. An example of such questions that might relate to a spider in

a web might include: How many spiders were there? In what portion of the web was the spider located: upper left, lower left, center, etc.? To what objects were the web "cables" attached? What was the dominant color of the spider? Students should write down the answers to insure full participation.

NATURE NUMBER QUIZ

Mark off a specific trail or route for your students to follow on the school grounds. Place tags on the trees, shrubs, weeds, grass, animal homes, and other objects along the trail. Each tag should have a question, two choices, and a number value for each choice. Students read the question and then select the right answer. The students should record the number value of their choice. It is usually better to use odd numbers for the values so that no one can get the correct final number without getting all the questions correct. The total score should be compiled at the end of the trail and then go back over each tagged item with the class. An example of a tagged item would be: if this tree has a simple leaf, take 5 points. If this tree has a compound leaf, take 3 points. Another method of asking the question would be: what kind of leaf does this tree have - simple leaf - 5 points; compound leaf - 3 points.

LEAF SKELETONS

Have your students collect a few fresh green leaves from the campus. Make a pounding board from a piece of old carpet tacked to a wooden block. Place the leaf on the pounding board veined side down. Hold the leaf firmly with one hand and gently tap the fleshy parts of the leaf with a fine bristled hair or shoe brush. Brushes with animal bristles work better than those with synthetic bristles. Occasionally turn the leaf over and work on the undersides. To preserve leaf skeletons, cement them to dark colored construction paper or cardboard. Label the leaf and cement a pressed specimen of the entire leaf next to

the veined skeleton. Art students may wish to paint the skeletons and arrange them in pleasing patterns.

LEAF PLAQUE

Collect a variety of leaves from the trees, shrubs, and weeds on campus. Prepare a cardboard ring that is approximately one inch wide and large enough to encircle the leaf being cast. Grease the leaf with vaseline and place it vein side up on a piece of newspaper. Tie a piece of heavy string into a loop. Place the string loop into the cardboard ring so that half of the loop is outside the ring. This will allow you to hang the plaster cast on the wall. Now very slowly pour some Plaster of Paris onto the leaf and string loop. Fill the cardboard collar with the plaster. Allow the plaster to dry overnight. Remove the cardboard ring and peel off the leaf. Gently wash the cast with warm soapy water. Paint the cast and the leaf print in contrasting colors.

PLANT MAPPING

Students create a map of the school grounds showing where different kinds and numbers of plants are growing. Use colored pencils. Attempt to give reasons for the plant distribution as shown on the map, considering such factors as disturbance from machinery, shade, sunlight, soils, moisture, foot travel routes, or any other factors that seem appropriate.

PLANT STRESS

Students should locate five or more examples on the school ground where man has caused some stress or injury to local plants. Discuss the importance of plants to man as oxygen-producing agents. Other students may wish to consider the effect on plants along driveways or at stop lights, where idling buses and car exhaust cause plant damage from carbon monoxide entering leaf stomata and displacing oxygen. High schools may use infra-red film to recognize plant stress.

PLANT REQUIREMENTS

Review the three Basic Life Requirements of plants: Sunlight (food), Water, and Oxygen. Have students take a survey of the areas on the school grounds where plants do not grow. Determine which of the major life requirements for plants is missing. (Bare ground on paths or playground sites can be related to soil compaction, which reduces the necessary amounts of oxygen in the soil. Stress the importance of burrowing organisms and plant roots to loosen and aerate such soils.)

HOW OLD IS A BRANCH?

Have your students determine the age of tree branches on the campus. Starting at the tip of a branch, locate the terminal bud (the last bud on the tip of a twig or branch). Now move along the stem until the first bud scale scar is located. The scar completely encircles the branch and is the point where the last growing season's terminal bud was located. Usually, the distance between the bud scale scar and the terminal bud represents one year's growth. Then continue down the branch toward the tree's trunk to the next bud scale scar. The distance between the bud scale scars is one year's growth. How old is the branch? In what year did the branch grow the most? Do other branches on this tree show the same growth pattern? How often does this tree compare with otner trees? What could have caused more growth in one year than in another year?

TREE BRANCHES

Divide your class into small groups. Give each group a magnetic compass and the following instructions: Stand beside the trunk of a tree. By using the compass, determine in which directions the main branches of the tree are growing. Record the information as well as the type of tree you are examining. Do more branches grow in one direction? If so, what is that direction? Do other trees of the same type have a branching pattern? Is the branching pattern affected by buildings, other trees, and the prevailing winds?

PLANT DECOMPOSITION RATES

Have your students determine the rate of leaf decomposition of different campus plant species. Divide the class into small groups. Have each group collect leaves from different species of plants. Dry the leaves at 100°C for 48 hours in a drying oven. Divide each species into 10 gram piles. Place each 10g. pile into a bag made from plastic screen mesh or loosely woven fiberglass. The bag should be large enough so that the leaves do not overlap. Clear an area on the campus so that the leaves in the bags can come in contact with the soil. The bags should be secured in place by pinning the bag to the soil with nails. Another method is to cover the bags with chicken wire and secure the wire to the soil. Prepare 4 bags of each type of leaf. Every 2 weeks remove a bag, dry, and weigh. Keep a graphic record of the results. Which species of leaves decomposes the fastest? Which decomposes the most during the first 2 week period? Can you think of reasons for the differing rates?

PLANT PARTS

Take your students out on the campus and have them identify parts of plants. Before going outdoors explain and point out the general plant parts: stems, branches, roots, leaves, and buds. As you walk around the campus, have random students name a plant part. The student must name a plant close at hand and point out the part named. This will help students learn the parts as well as the similarities among plants.

SEEDS AND THEIR DISPERSAL

Have students search the weedy areas of the campus for six different kinds of seeds. Then return and display the seeds, with the teacher leading discussion on what seeds are and how each type of seed is dispersed (e.g. hitch-hiking spiny seeds, wind-dispersed feathery or winged seeds, bird-scattered smooth seeds, etc.). Have students predict what types of plants would be found in different parts of the campus according to dispersal methods.

LAWN PLANT ADAPTATIONS

A study of lawn weeds can be conducted by comparing a lawn before and after mowing. Have students determine which of the lawn weeds seem to be most successful in adapting to being mowed. Which growth forms do the successful weeds take? Find examples of rosettes, creepers, sprawlers.

A SHAPE OF A TREE

Have your students locate various trees on or near your school campus that are oddly shaped. Try to determine what caused the tree to take its present shape. Trees near buildings often curve outwards due to lack of light, or become onesided. Look for signs of pruning. Some limbs are destroyed by passing trucks and buses. Look for old wounds on the trunk and signs of terminal bud destruction (pine trees usually will have a sharp curve in the trunk due to destruction of a terminal bud). Observe wound areas for signs of rot, and for signs of the bark growing over the wound.

STUDY IN VARIATION

Choose a shrub, vine or tree which contains a compound leaf. (A single leaf comprised of numerous small leaflets.) Without picking the leaves, have each student choose several examples, counting the number of leaflets contained on a single leaf. Now the student should compute the average, or mean number of leaflets per leaf. Compare the results of the class sample with the results from individual students. Discuss which result is the most accurate and why. Other variations can be done with the number of flowers on a weed, thorns on a given length of vine, stickers, number of teeth on a leaf margin, etc.

SPORE PRINTS

Collect mature mushrooms from the campus. Coat a sheet of white paper with mucilage or some other slow drying glue. Obtain four toothpicks and tie a heavy knot with string about halfway up each toothpick. Cut the stem of the

mushroom off directly below the cap. Stick the toothpicks into the bottom of the cap at four different locations to form legs. The string knots will prevent the cap from sliding downward and the toothpicks will hold the cap above the mucilage coated paper. Place the mushroom cap onto the paper and cover the cap with a bowl or jar. This will prevent air currents from disturbing the spores as they fall from the cap. Let the cap stand for a full day. Remove the bowl or jar and allow the mucilage to dry. Coat the entire paper with a clear spray fixative or clear spray shellac. The prints can be displayed in frames and used as wall hangings or to help identification of the mushrooms.

SOIL FUNGI

Collect soil samples from different areas of campus. Weigh one gram of soil from each site. Prepare 45ml of sterile nutrient agar with a pH of 5. Divide the agar equally among five test tubes. Cool the agar to approximately 45°C (cool enough to hold in your hand). Place 1 gram of soil sample in the first test tube. Mix thoroughly. Transfer 1 ml from tube #1 to test tube #2, and then transfer 1 ml from tube #2 to tube #3. Continue this dilution technique until all tubes contain a soil and nutrient agar mixture. Now pour the contents of tube #1 into a sterile petri dish. Repeat this procedure for other tubes. Incubate the petri dishes for 7 days in a warm dark place. The petri dishes now contain the following amounts of soil: Dish #1 has .1 g, dish #2 has.01 g, dish #3 has.001 g, dish #4 has.0001 g, and dish #5 has .00001 g. Count the number of different fungi and make drawings of each. Record color differences. Record the number of fungi for each dilution and calculate the total number per gram of soil. How do the different areas compare? Does the amount of organic matter affect the number of fungi?

PLANT RESPIRATION

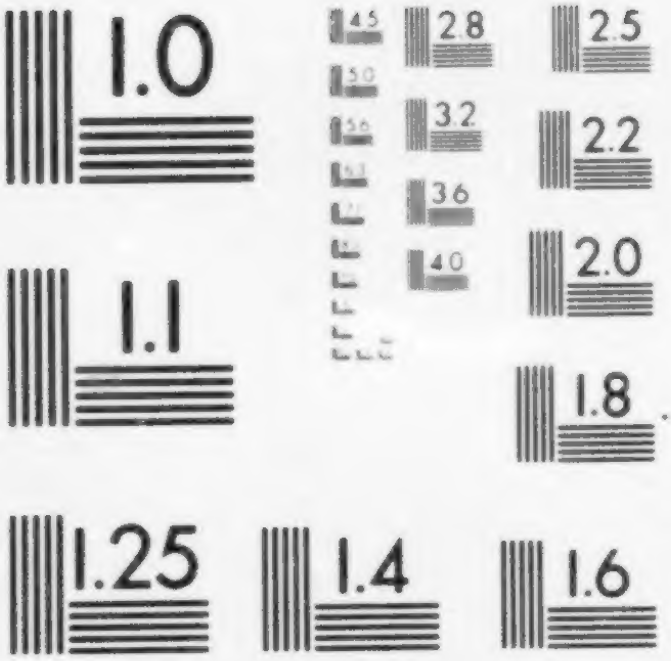
To demonstrate plant respiration to your students take them outdoors to a tree or shrub on campus. Place a clear plastic bag around the tip of one branch and securely fasten the open end of the bag around the stem. Water drops will form on the inside of the bag. Where does the water come from? Fasten bags to several different plants. Which ones produce the most water from respiration? Which ones would survive best in a dry climate?

MEASURING LEAF EVAPORATION

Select a leaf on a tree and make a leaf sandwich of it by placing a layer of saran wrap on the top and bottom of the leaf. Do not remove the leaf from the tree. Between the leaf and saran wrap place a strip of cobalt blue paper. Hold the entire thing together with paper clips. Check the leaf periodically and record the time it takes for the cobalt chloride paper to turn from blue to pink (Dry to wet). Try several leaf sandwiches. Compare different species of plants from different micro-communities - dry sites, wet sites, sunny, shade, north side of building (shady side), with south side of building. Record and list the data.

THE CAMPUS FOREST

Few school grounds have real forests, but most have hedges. A hedge acts in much the same way as a forest. What types of plants grow along the edge of the hedge? Are they the same as those directly under the hedge? Is the soil more moist under the leaves or in areas without leaf litter? Dig into the upper two to three inches of soil; can you see any evidence of decayed leaves in this soil? What are these leaves adding to the soil? Where can the most light be found: outside the hedge, at its edge, or under the hedge? How do these light differences affect what types of plants grow in the area? How do you think a real forest differs from the "hedge forest?"



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

WATER DEPENDENCE IN PLANTS

Water makes up a large percentage of plant and animal matter. Plants, like animals, would die off if water were not available to them. A general rule of thumb that can be used in ecological studies is that the percent of water content making up a plant or animal is a measure of water dependence for that organism. Have each group of students select a different area of campus from which to sample plants. Try to include dry areas, wet areas, and areas that show gradations between these extremes. Record on a campus map where the areas were, the relative wetness or dryness, abundance of vegetation, soil types, and types of vegetation. Have the students collect samples from the most abundant plant species from each study site. Place the dishes in a drying oven for 48 hours at 105°C. Weigh the dried sample and subtract the dry weight from the fresh or wet weight. Divide the difference between wet and dry weights by the wet weight. Multiply this answer by 100 to get the percent of water content. Do the plants from the dry areas have more or less water content?

MEASURING THE LEAF AREA AND VARIATION OF LEAVES

Pass out graph paper to students. Visiting a weedy area or a tree on campus, students should each collect 1 leaf. All should have a leaf from the same species of tree or weed. With pencil, students trace the outline of their leaf onto the graph paper. Students count all the whole squares inside the outline and the squares which are only partly within the outline. (A more accurate method is to estimate, with the use of decimal points, the percent of partially covered squares enclosed within the leaf tracing.) Teacher should list on the board the class results in numbers of graph units covered by their leaf outline. An average can be computed. Measure the true size of a graph unit and compute the actual size in square inches of the surface on the entire tree. (If you told them that X amount of oxygen was produced over X period of time per each square inch of leaf surface, how much oxygen would be produced per leaf; per tree in a given day?

AUTOMOBILES AND TREES

Emphasize with your class how green plants are the only source of oxygen on the earth. For every automobile that emits carbon dioxide into the air, fifty large healthy trees are needed to restore the oxygen that was used. The class should study the school grounds, working in pairs or small groups and count the number of cars in the parking lot versus the number of trees on the school grounds (small trees or shrubs should be counted only as fractions of a "large healthy tree"). Do the school grounds have an oxygen surplus or deficiency? How many more trees would be needed to create an oxygen balance? Discuss the added effect of cars driving past the school. Have students suggest from a map which local areas should have an oxygen surplus to compensate for the reduction in their area.

CRACK PLANTS

Take your students outdoors to a sidewalk. Scrape the dirt out of several sidewalk cracks. Place this dirt in a small cup or a depression in an egg carton. Scrape dirt from different cracks along the sidewalks, keeping track of the sample location. Label each pot (cup or carton) with the location from which the dirt was taken. Water the pots and place them in a warm sunny area. When the plants are two to three inches tall, carefully transplant them to larger pots or tin cans. More than one plant can be placed in a pot. Be certain to remove any new plants that sprout in these new containers since they are not from the sidewalk crack. but from the new soil in the pot. How many different kinds of plants grew from the seeds in the cracks? Are there any plants from one location that were not found in other areas? Are any plants common to all locations? Try to find plants like those in your pots outdoors near the sidewalks. Look for seeds on these plants and try to determine how the seeds got into the sidewalk cracks.

FERN GARDENS FROM SCRATCH

Have your students bring in fern fronds with sporangia on them. Try to get as many different types as possible. For each species of fern brought in, use the following procedure: Fill a flat pot saucer half full with small pebbles. Cover the pebbles with a mixture of sand and leaf mold. Cover this mixture with a thin layer of fine sand. Sterilize the pot saucer and its contents in an oven at high heat for 15 minutes or autoclave at 15 p.s.i. (pounds per square inch) for 15 minutes. Allow to cool, and cover with a piece of glass. After cooling, add water until the soil and sand are moist. Then sprinkly spores form the fern thinly over the surface. Replace the glass cover and incubate in a warm shaded spot. In a few weeks microscopic heart-shaped prothallia will appear. In another week or so, small fronds will be seen. When the plants are about one inch tall, transplant them to a seed flat. After a few weeks transplant the ferns to a fern garden area outdoors. This area should have plenty of decayed leaves and sticks mixed in with the soil.

DECOMPOSITION

Early in the year bury some "typical" garbarge (glass, bottles, aluminum and steel cans, plastic bottles, cardboard, other forms of paper, food, etc.). If possible, take photographs of the items before you bury them. If a camera is not available, make sketches and observation notes. Mark the sites so that they can be found later in the year. Bury each item about one foot deep. Near the end of the school year, dig up the materials. Compare the before and after effects of the decompostion on plastics and aluminum

BOARD FEET IN A TREE

Take your class out on campus and determine the number of board feet of wood contained in campus trees. Determine the height of the tree from the ground to a point near the tip where the tree is about 8 inches in diameter. (There are several exercises in this booklet that deal with estimating tree height.)

Determine the diameter of the tree trunk four and on half feet above ground (Diameter Breast Height). Next, determine the number of logs in the tree. A log is a section of the tree that is 16 feet long. Trees are cut into logs in order to haul them to the saw mill. To find the number of logs, divide the height of the tree by 16 feet. Finally, put your data into the chart to obtain the number of board feet. Remember, a board foot is a board 12 inches long by 12 inches wide by 1 inch thick.

Diameter in inches	Number of 16' logs 1	2	3	4	5	6	7	8
12	62	80	133	183	235	286		
14	64	88	147	210	274	338		
16	67	96	163	242	320	399		
18	71	109	190	280	370	459	550	701
20	75	122	221	330	435	543	651	758
22			258	383	509	633	760	884
24				438	584	728	882	1035
26					666	832	1013	1190
28					750	941	1114	1346
30					850	1062	1291	1518
32						1195	1149	1700
34						1333	1614	1898
36						1494	1782	2095
38							1955	2305
40							2150	2523

How many board feet are in all the trees measured? How many picnic tables could be constructed from the campus trees? (First determine the number of board feet in a picnic table.) Are these trees more valuable left where they are or as lumber? Why?

NATURAL COLORATION AND SURVIVAL

Purchase or color toothpicks in the following pattern: 100 red, 100 green, 100 yellow, 100 blue; leave 100 with their natural color. Take your class outdoors to a grassy spot and mark off a one square meter area. Spread the toothpicks evenly throughout the area. Give a pair of students the following instructions: You are a toothpick-eating bird. You have two minutes to capture toothpicks. You can use only one hand; place your other hand in your pocket or behind your back.

Allow 4 or 5 pairs of students to try the exercise. Replace the "captured" toothpicks after each trial. Keep a record of the number of each color captured for each trial. Make a bar graph to show the results. Which color was caught the least number of times; the most? Why? Discuss protective coloration. What would happen if a different background were used; for example, dry leaves, sand, etc.?

As a twist to this activity, place a tight rubber band around the thumb and index fingers of one of the "birds." How does this affect captures? Are some "birds" better adapted for hunting toothpicks than others? An eye patch over one eye can also bring some interesting results.

SCAT BOARDS

Many of the animals living on or near the school campus are nocturnal. Evidence of their presence may be seen by placing baited scat boards in different areas of the campus. A scat board is simply a six-to-twelve inch square of plywood or tile used to observe animal droppings. Place a small amount of rolled oats and peanut butter mixture on the boards as bait so that the animal will stay long enough to deposit droppings. If the area around the scat board is sandy or dusty, animal tracks can also be found. Unbaited scat boards can also be used. Compare baited to un-baited boards. Which areas of the campus

show the most evidence of animal activity? Examine the droppings for seeds and parts of other animals that may have been eaten.

PLANT CARDS

Provided in the classroom with light cardborad and clear contact paper, students collect a representation of plants, (weeds, ferns, leaves, grasses, etc.). Each species is carefully sealed beneath the contact paper and attempts should be made to obtain their proper identity. The completed product can be placed around the wall or serve as flash cards to familiarize students with local flora. The teacher should practice the technique prior to demonstration. Care need be taken to avoid bubbles of trapped air beneath contact paper. Specimens should last for several years.

MOSQUITO CONTROL

Study the mosquito's life history, breeding habits, and effect on man. Then go out on campus and look for actual and potential breeding sites. How can these areas be changed to prevent mosquito production? If possible, collect a few mosquito larvae and examine them under microscopes. Also set up two study jars containing larvae. Put oil on the water in one and leave the other alone. What happens?

TEMPERATURE BY THE CRICKETS

Naturalists have discovered that the warmer the temperature, the faster the crickets sing away. On cold days crickets chirp much more slowly. Search the school ground and listen for the sounds of crickets beneath boards and stones and keep them temporarily in the classroom. Using a watch with a second hand, single out one cricket. Count the number of chirps he makes within 15 seconds. Add the number 38, to the total. The count you obtain will be close to the official temperature.

CAPTURING SPIDER WEBS

Go out on campus and locate a spider web. Gently remove the spider from the web. Spray the web with enamel spray paint; use a good quality paint. Cut a piece of black construction paper slightly larger than the web. Spray the paper with a clear drying fixative spray or clear enamel spray until the paper is wet. Gently place the wet paper against the painted web. Next cut the web from the objects to which it was attached. Display the captured webs in the classroom.

Make a study of spider webs. Each kind of web indicated a different kind of spider.

INSECT BEHAVIOR - KINEKINETIC VERSUS ORTHOKINETIC

Insects under stress are said to typically exhibit one or two forms of behavior: (1) Kinekinetic behavior (which is simply a speed increase); (2) Orthokinetic behavior (which is simply a greater amount of turning). Students should work in pairs with a sheet of paper with two columns for each of the terms, which can easily be simplified. Testing a variety of insects in the field and placing them under stress by gently touching them with pencil or fingers, students should record on their work sheet the form of behavior (one of both) that was demonstrated by the insect. A wide range of insects should be tested (ants, spiders, ~~centipedes~~, beetles, crickets, etc.). Class should compare their results and attempt to show predictable patterns of behavior for various insects. Centipedes and millipedes can also be tested in this way.

LEAF MINERS

Look for signs of leaf miners, insects larvae that live between the top and bottom layers of leaves. A winding trail will be visible on the leaves of weeds where miners have eaten. The trail will be most narrow there the larvae initially hatched and will widen as testimony of the insect's growth until it emerges at the widest point of the trail. Any weedy area should have abundant examples. Ask students to find an example of a leaf miner trail. Trace the trail to show where the insect began and where it emerged. What types of weeds do they prefer? What would be the advantage of living inside a leaf? Allow students to draw what they believe the animal looks like.

MEASURING FRIGHT DISTANCE OF BIRDS

Certain birds species seem to be more timid than others. Various species will allow you to approach so close and then fly away. This distance is the fright distance. Needed is a white cloth with a stone for weight, a tape measure, pencil, and paper. Students walk until they sight a bird. Walk slowly toward the bird until it flies away. Drop the cloth when the bird flies and walk to the spot where the bird was. Measure the distance to the cloth. Repeat activity several times for best results. Using the same technique with different species, calculate the average fright distance. Which species of bird in your area allowed you to approach the closest? Which had greatest fright distance? Make a table listing most to least timid. Would shouting affect your fright distance?

MEASURING WITH SHADOWS

Older students can measure many large objects with shadows, since the size of a shadow is directly proportional to the size of the object. Thus, is a 12-inch ruler held perpendicular to the ground throws an 8-inch shadow, and a tree shadow

is 18 feet 6 inches (222 inches) long, the tree will be 27-3/4 feet tall (8:12:: 222:x). Calculate the height of trees or the flagpole on campus.

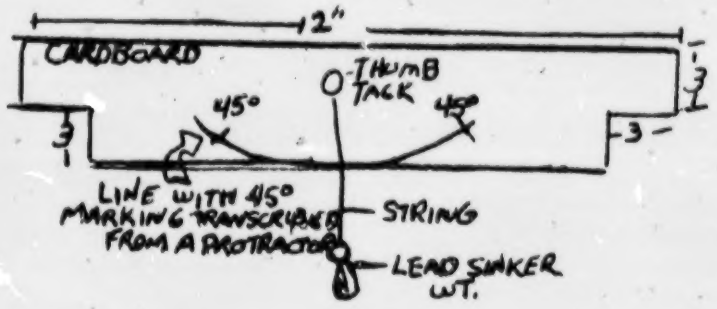
HEIGHT OF OBJECTS - THE MUDDY WATER METHOD

To estimate the height of trees, poles, and buildings, have your students mix up some mud and water in a large basin or dissecting tray. Place the container of the muddy water on the ground between the student and the object to be measured. Step away from the container a distance equal to that from your eyes to the ground. The top of the tree, pole, or building should be seen as a reflection in the muddy water. If not, move the basin one way or the other until the reflection is seen. The distance from the container to the foot of the object is equal to the height of the object. A mirror can be used instead of the muddy water if it is available.

USING THE CLINOMETER TO MEASURE HEIGHT

Have your students construct simple clinometers and use them to help determine height of trees and buildings. Use sturdy cardboard, a thumb tack, short piece of string, and a small weight in the construction (see drawing). A protractor is also needed to help designate lines of degree on the clinometer.

Clinometer Construction Details



To use the clinometer, back away from the object to be measured until an imaginary line from your eye to the top of the object forms a 45° angle to a horizontal line from your eye to the object. Sight along the top of the clinometer until the weighted string is resting on the 45° line.

The lines of sight along the horizontal and 45° angle form two sides of a right isosceles triangle. The 45° line is the hypotenuse, thus the distance from

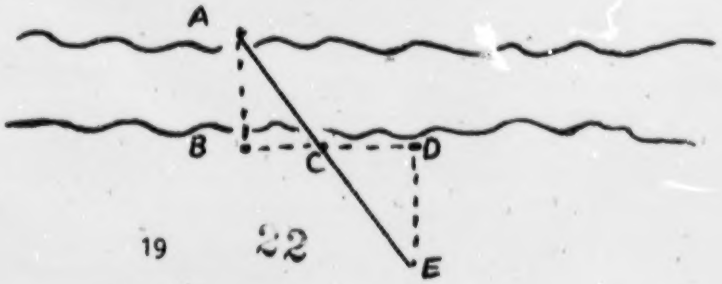
the object to the person along the horizontal line is equal to the height of the object.

MEASURING YOUR PACE

Have each student, with the help of a partner, measure his own pace. (A normal step measured from the toe of the rear foot to the toe of the front foot.) Students should write down the measurement of their pace to the nearest ½ inch. Teacher should measure and mark off a distance of 100 feet on the school grounds. Students should walk the distance twice -- count the number of paces each time and compute their average number of steps. Now divide the 100 feet distance by the average number of steps taken. The answer will be their pace. Compare this to their original measurements. Now have each student measure (by pacing) the distance from the step outside the classroom to the office and back; to the gym and back; to the flagpole and back; the bus stop and back, etc. Students compute each distance to inches; write class results on board for each distance measured.

MEASURING DISTANCE ACROSS A CANAL OR ROAD

Leading students to a canal, highway, blacktop court, etc., on campus, demonstrate a technique that could be used to measure distance across a river, gorge, etc. Select a mark on the opposite side (see drawing - A). This might be a tree, a distinctive bush, or a stake previously placed there. Place a stick in the ground on your side (B). Walk at right angles to the canal for a known number of paces and put in another stake (C). Continue in the same direction for the same number of paces and place another stake (D). Now turn at a right angle away from the canal and proceed in a straight line until stake C is in line with marker A. At this point place another stake (E). The distance from stake D to stake E will equal the distance across the canal. (BC = CD DE = AB)



ESTIMATING DISTANCE

This activity can be done by small groups or by individual students. Take you class outdoors to a relatively flat area; a football field works well. Place a stake in the ground and stretch a piece of string 200 feet from the stake. Fasten the other end of the string to another stake. Be accurate in this measurement. If possible, use a 100 foot measuring tape to determine the distance. Give each group of students three straightened coat hangers and three file cards. Tape the cards to the coat hangers to form flags. The cards should be colored white, red, and blue. The students should put their names on all three flags so that they can be identified during the exercise. Using the white flag, students should guess where the 100 foot point would be along the string. In order to do this, the class should move away from the string and then make a guess. Place the white flag at the guess point. After the guesses have been made, have the students estimate where the 100 foot point would be by pacing. Place the blue flag at this point. Finally, give each group a yardstick or ruler to actually measure the 100 foot distance. Which method worked best for the majority? Why were there differences even when the yardsticks and rulers were used. What was the range on guesses; the estimates; the actual measurements? Where was the smallest range found? Why? Determine the mode and the mean for each trial.

POLLUTION MATH

Instruct the class to bring paper and pencils and sit in a group outside under a tree. The following exercises are a good outdoor "warm-up" and can be used to precede any of the math exercises in this booklet.

1. One American is responsible for one ton of garbage per year.
   (a) How many pounds is this per day? (b) How many pounds per day for the class? (c) What happens to this trash?
2. Air pollution costs the average American $65.00 per year. How much is this for the entire United States?

MATH WITH SANDSPURS

How many spines does a sandspur have? A simple math exercise allows students to compute the average number of sandspur spines on a given sandspur. Students collect a representative sample of "spurs"; count and compute the average number of spines. For additional alternatives, compute the average number of "spurs", not spines, for plant. Compute by sampling techniques, the total number of plants for the school grounds. How many spines would this be? A variation of this can be conducted with the average number of seeds per grass or weed.

WORD MAPS

Divide your class into small groups. Each group is to describe a map route or trail to some place on campus. No drawings can be used. Exchange word maps and let each group try to follow the word trails. This activity can be varied by allowing only five words for each direction given, or by stipulating that direction movement must be changed six times, but only five word directions can be given. Discuss the value of using the right words.

HAIKU POETRY

Haiku poetry was originated by the Japanese. The emphasis is syllabic, not rhyme. It consists of three lines. The first line has five syllables, the second has seven, and the third line has five syllables. The art of Haiku is to capture in words the "quick reaction" one gets when observing something that dramatically catches the eye. In subject areas such as science and social studies, Haiku poetry can used to stimulate discussion of such things as animals and plant life, food webs, pollution, human relationships, building codes, transportation problems, etc. Below are two examples of Haiku:

Bitter blue berry
As blue as the sky above
Feeds the hungry birds.

Dark moving shadow
Passing over the ground
It is only me.

CINQUAIN POETRY

Cinquain poetry emphasizes syllabic form and is similar to Haiku. Cinquain has five lines. Each line has a specific number of syllables and purpose: line one is a title containing two syllables; line two is a description of the title in four syllables; line three tells of action in six syllables; line four gives a feeling in eight syllables; and line five uses another word picture for the title in two syllables. In subject areas such as Science and Social Studies, use this form of poetry to start discussions on specific topics. Below is an example of Cinquain:

Sandspur
Rounded pointed
Sticks tightly to the flesh
You miserable curse of beast
Painful

WHAT WAS EARTH LIKE?

Take your class outdoors and give them the following assignment. Tell the class that they are from a planet in another solar system. "You have just landed your spaceship and are now looking around this new environment. Your commander is asking you to report what you see. Remember that your commander has never seen such things as trees, grass, people, sidewalks, cars, buildings, etc. Create a story telling what you see, hear and feel. For younger students the story can be developed through oral means, while older students can actually write their impressions

CREATIVE WRITING: THE FUTURE - THE PAST

Have your students find a pleasing spot on campus and sit there. Give the students the following situation: "The year is 2075 and there are well over one million people living in Pinellas County." Have the students write

about what the area in which they are sitting will be like in 2075. Now they should write about what the area looked like when they were high school students. Discuss the stories and ask how some of the harmful things could be avoided.

"ADD-A-LINE" STORIES

Take your class outdoors and have them create a story by allowing one person to begin telling the story. The first person gets no more than four sentences, then the next person must add to the story. Each successive student can add up to four sentences. The story should take place on the school grounds. If possible, make a tape recording of the story and play it back later in the year. Allow the students' imaginations to flow freely.

OUTDOOR FIGURES OF SPEECH

Have your students go outdoors and write short paragraphs describing things they see. They should use alliteration, metaphore, simile, hyperbole, and onomatopoeia for their descriptions.

SEASONS WITH A CAMERA

If deciduous trees are available to you on your school campus (cypress, red maple, etc.), it becomes an excellent project to make a photographic record of the tree throughout the season, as its leaves develop, reach maturity, and eventually fall. Utilize the same stake or fencepost for your camera to better insure the identical angle each time photo is taken.

TEMPERATURE TAG

Divide the class into small groups. Give each group a thermometer and piece of paper with a temperature printed on the top. The students should go outside and find an area that has the same temperature as that on their paper. They should then write a short description of the area. Why were the temperatures different in different areas? Use the written descriptions to help explain differences.

THE NATURAL HISTORY OF AN EARTH SPECIES

Before giving students any further information on the activity, instruct each student to collect 3 pieces of litter from the school grounds. Tell them they will be used for an activity in the classroom, but give them no further direction. Have them spread all 3 pieces before them on their desks. Now inform them that each student is a space scientist who has landed on a strange planet. The planet is in one of its long night periods which might last many earth weeks. Observation is impossible due to darkness. Your ship's Robots have scanned the area and returned with only the 3 pieces of litter you have before you. The 3 items have indicated to you that there is life on the planet. Problem: Each student should concern himself with his own three pieces of litter. Assuming no more information than the litter provides, draw as many conclusions as to the size of the species; what they might look like; what they eat, drink; where they live; what is their level of intelligence; do they have eyes, and, if so, would rods or cones dominate? (Color in litter indicates cones and, therefore, activity principally during daylight.) Finding a coke can might indicate many things from the types of metals on the planet, etc. What would the contents of the can be used for? Consider if all the material is from the same species or many species.

Remind students that, based on the 3 pieces of litter they have, it would be correct to form deductions that, although logical, they know to be false. Once each "space scientist" has drawn his fullest amount of deductions, based on his 3 pieces of litter, he should formally present them (as if at a formal seminar) to the class, who would represent a gathering of leading scientists back on Earth. The class (scientists) should critically challenge the deductions and the speaker should be prepared to support them. The use of a podium and microphone will aid in formalizing presentations.

SOIL AND WATER MOVEMENT

Divide your class into small groups. Give each group a quart can with both ends removed and a gallon of water in a bucket or milk jug. The object of this activity is to determine how different soils affect the movement of water. Each group should pick a different area of the campus to do their sampling. The can should be pressed about 1 inch into the soil at the sample site. Next, pour one gallon of water into the can and record the amount of time it takes the water to completely seep into the soil. If watches are not available, one student can roughly count off the seconds. Give each group a question page on which to keep their data:

What was your longest time?_____ Shortest?_____

What is the difference between soils?_____

Which soil is better?_____ Why?_____

How does man affect this rate?_____

What type of vegetation did you find at: longest time area?_____

shortest time area?_____

Why were these plants there?_____

Other questions can be added to this list as the situation warrants.

SOIL LEACHING AND PERCOLATION

Have your students determine the percolation rate of different soils on the campus. Divide the class into small groups and give each group a large tin can with both ends removed. Attach two or three layers of cheese cloth to one end of each can with rubber bands. Send the students outdoors and have them collect soil samples from different areas of the campus. Fill each can with soil from the sampling areas. Pack the soil into the cans so

that it is approximately as compacted as it was at the sampling site. The cans should be filled within two inches of the top of the can. Hold the cans over clear jars or dishes. Pour three hundred milliliters of water into each can. Keep a record of the number of seconds it takes the 300ml of water to be absorbed by the soil. Measure the amount of water that ends up in the dishes. Compare the clarity of the residue waters. Which soils allowed the water to pass the fastest? Why? Which residue water was clearest? Why? Examine each sampling site for types of vegetation. How do the leaching effects and percolation limit plant growth?

DISSOLVED SOLIDS IN SOILS

Collect soil samples from different parts of the campus. Some samples may be taken from holes dug in the earth. Record where each sample came from. Mix a specific amount of soil with demineralized or distilled water. Filter the soil and water mixture. Allow the filtrate to evaporate or boil it to remove the water. Which soil has the most residue? Can any reasons be given for these results? The procedure can be done quantitatively by accurate measurements of soil, water, and residue if your students wish. Chemistry classes can further analyze the residue qualitatively..

SOIL TESTING

Locate an area on campus where the lawn grass is not uniform in color or texture. Divide the class into teams of three or four students per team. Give each team a small paper cup and a tongue depressor. Delineate a study area on the lawn that is approximately ten to fifteen meters on a side. The groups should distribute themselves evenly throughout the study area. One member of the class should make a map of the study area and indicate each group's position. Allow the students to decide on the method of distribution. The map should also include a rough approximation as to where the grass is growing well and where the texture and color do

not seem normal. Each group should use its tongue depressor and scoop up 3 to 4 teaspoonfuls of soil from their sampling site. If other tests are going to be made, label the tongue depressors and push them into the ground at each sampling spot. Mix distilled water with the soil in each paper cup until the soil is muddy. Give each group a piece of red and blue litmus paper. Place the litmus paper into the mixture and allow them to stand for about five minutes. If the red litmus turns blue, then the soil is basic or alkaline. If the blue litmus turns red or pink, the soil is acid or acidic. Now transfer the results of this soil test to the map. Is there a correlation between the test results and the differences noted in the lawn grass? Was the grass at your test site healthy or unhealthy looking? What could be done to improve the health of the lawn?

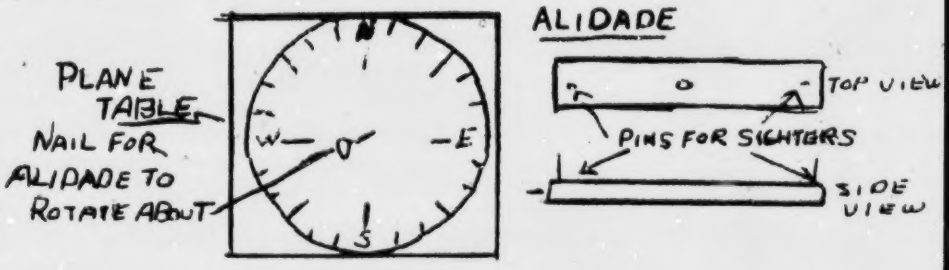
ESTIMATING ORGANIC MATTER IN THE SOIL

Have your students collect soil samples from different areas of the campus. The sampling sites should contain different types of plants and, if possible, different soil types. Each sample should be approximately 2 cc. Mark the sites on a campus map. Place each soil sample in a test tube. Add approximately 6 ml of 2% NaOH and shake for a few minutes. Allow the mixture to stand for 48 hours in a covered test tube. After the 48 hour period, observe the color of the solution above the soil. If the solution is dark black, the soil is medium in organics, and, if the solution is any other color, the soil has a low organic content. What does organic matter add to the soil that plants need? What types of plants were growing in the low, medium and high organic content soils? Which soils would hold water the longest? Why?

MAPPING WITH A PLANE TABLE AND ALIDADE

Have your students construct 2 plane tables and alidades and map the campus. This is a triangulation method of mapping. The plane tables can

be constructed from two 2 foot squares of plywood. Draw a compass face on the plywood squares. Delineate the degrees and the compass directions with ink. The alidade is a siting device that rotates from the center of the plane table (see drawing).



Place each plane table and alidade 100 feet apart. Align each table so that the north designation on the table is pointing due north; use a magnetic compass for this. Each table uses the alidade and sites on an object. Record the degrees <u>from</u> north to which the alidades are pointing. Do this for several objects, trees, buildings, corners of ponds, etc. Determine a scale for your map. Set up the scale 100 foot baseline on the paper. Use a protractor and transfer the field degree readings to the map and triangulate the objects mapped.

<u>SETTING YOUR WATCH BY THE SUN</u>

Your watch can be set to the approximate time in the wilderness by the use of a compass. Find due South with your compass. Lay your watch on the ground beside the compass. Then, using a pencil or twig, cast a shadow over the watch to keep the hour hand of your watch pointed toward the sun. Turn the hands until South is midway between the shadow and twelve along the shorter arc. Your watch should then be set to within a few minutes of the local standard time.

<u>FINDING NORTH AND SOUTH WITHOUT A COMPASS</u>

A compass direction can be taken by measuring the points of a shadow

from the top of a stick in the ground. Placing a heavy stick or stake in the ground, place a marker (small stick or stone) where the top of the shadow ends. Every twenty minutes or half hour, mark a new shadow point. The points will show to be a curve, once four or more readings have been made.

Next draw a large circle around the post. (A string and marker will assure an accurate circle.) Continue the curve that is indicated from the markers until your curve cuts across the circle. The two points where the curve intersects the circle will give you - East and West. Connect East and West points with a straight line. Draw a perpendicular line through this to give you North and South.

(Twice a year, while the sun is directly over the Equator, March 21 and September 21, or within a week of either side of these days, the shadow will represent itself in a straight line - East-West.) Make a survival story out of the exercise; see who finds their way back to camp.

TELLING DIRECTION BY THE SHADOW TIP METHOD

When working with the compass or discussing shadows or the movement of the earth, take your students outdoors and show them how to find the points of the compass. Drive a stake vertically into the ground (the stake should be at least 3 feet above the ground. Place a marker at the tip of the shadow cast by the stake. Wait at least 10 minutes, and then place another marker on the spot where the shadow now falls. Draw a line between

the two markers. This line will always run East and West. The second marker will be pointing toward the East. North and South can then be determined by facing East; North will be to the person's left.

CAMPUS COMPASS TRIP

Prepare a series of compass headings and pace distances that will lead your students to a specific point on the campus. It is best to prepare several alternate routes so that different groups will end up at the same point, but not on the same trail. Give each group of students a compass and the directions on its use. Then give them a ditto copy of the compass headings and distances. Don't tell the groups that they are to end up at the same spot.

EDIBLE WILD FOODS

Numerous requests from teachers have indicated a desire to participate with students in some exercise dealing with edible wild plants. This is an extremely difficult area to experience, particularly on school grounds.

Be content with sampling small quantities, and do not plan to satisfy a meal requirement with your natural foods. Stress plant construction during your gathering outings, and take no more than your demonstration requires. A popular inexpensive book available, Edible Wild Plants of South Florida, by Julia Morton and A Field Guide to Edible Wild Plants, by Lee Peterson are valuable references with numberous suggestions.

Perhaps the most readily available item for a natural foods demonstration is the cattail (Typha), abundant along almost all local ditches, canals or wet sites. Pull up the plant complete with its roots by feeling with hands through the mud. The starchy roots should be cleaned and boiled like potatoes. The basal half of the stem is edible raw or cooked. Peeled stems of the young plants are a world-wide delicacy called "cossack asparagus." Gather the

greenish young flower spikes before they become tawny with pollen, and they can be husked, boiled and eaten with butter like corn on the cob. The long slender leaves may be woven into mats.

Arrowhead (Sagittaria), distinctive with its three petaled white flower, is widespread around the margins of ponds and canals. An historically valuable natural foods plant, the long running roots contain hard tubers, resembling small potatoes. Edible raw, the tubers taste better if cooked as potatoes.

Field trip opportunities or schools near the beach may collect purslane (Portulaca), Saltwort (Batis), or Glasswort (Salicornia), particularly the tops of the latter. Boil the plants in water and drain pan to lose much of the salt content. All are edible raw.

MAKING WILD TEA

Perhaps the most convenient and pleasant of our wild plants suitable for making tea is the Wild Savory or Pennyroyal, Pychothymus rigidus. This small shrub, 6" - 24" high, grows abundantly in our pinelands (always within pine areas). This mint has small bluish flowers and is extremely fragrant. Wash the outer branches of the plant and boil them in water. The resulting tea should be mixed with sugar and served hot or cold.

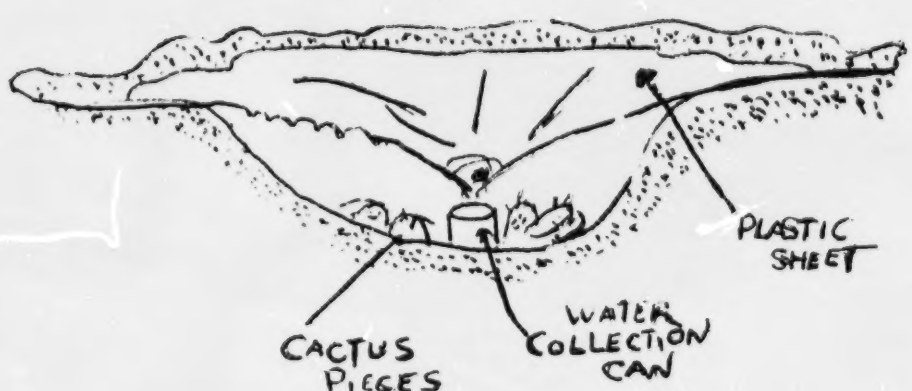
STORE-BOUGHT NATIVE FOODS

A simple natural food sampling demonstration can be presented to the class, utilizing store-bought native foods. Such items as swamp cabbage (the heart bud of a young cabbage palm)are available in cans from supermarkets. Beef jerky, comb honey, berries, smoked mullet, and other items may all serve to climax a discussion of pioneer foods with the product cut into small sample portions for each individual student. Another related classroom project involves pouring a pint of cream into a quart size bottle. Each student shakes the bottle vigorously and passes it on. Soon, chunks of

butter will float to the top. Spread the butter on crackers for students to sample. Stress the pioneer history of how each item was obtained and utilized.

A SOLAR STILL FOR COLLECTING WATER

A survival method for collecting water can be demonstrated by using a piece of light plastic sheeting about 4 ft. square. Dig a hole about 3 feet across and about 1½ - 2 feet deep in a sunny place (preferable in moist ground). A wet sand area on the beach also works well. If cactus or moisture collecting plants are available, cut them in chunks and place them in the hole. In the bottom of the hole place a collecting receptacle (jar or can). Lay the plastic sheet over the hole and weight edges with stones to seal edges as tightly as possible. Place a stone in the middle on top of the plastic sheet above the approximate center of the receptacle. Moisture from the soil or plants will be drawn up by the heat of the sun. The cooler air above the plastic will result in condensation - the moisture of which will collect and run down the plastic to the lowest point where it drips off into the container. Choose a sunny day for your experiment. 1-5 pints of water may be collected in a day using this technique.



DECOMPOSERS

Take your students to a shady spot near the school. There should be some small weeds and grasses in the area. Push a stick about the thickness of a pencil and approximately 10 inches long into the ground. Push an apple onto the stick. The stick will hold the apple so that animals cannot carry it away. Keep a daily record of the changes that take place. How long did it take before the skin was broken or for signs that animals had chewed on it? When did insects and worms appear? When did the first odors become noticeable? When did fungi appear? How long did it take for the apple to completely disappear? What would happen if there were no decomposers?

DICE'S METHOD OF POPULATION ESTIMATION

Dice's method is used to estimate plant populations and sessile animal populations. Locate a study area on campus that contains several varieties of weeds, shrubs, and/or trees. The size of the study area is determined by the type of plant being studied; grass study areas are usually one square meter; small shrubs and weeds five square meters; and trees 10 square meters. Once the size of the study area has been determined, place a stake in each corner of the study plot. Next, divide the study area into quadrants (four equal parts). This can be done by using wooden stakes with string stretched between them. Divide each quadrant into several quadrats. Quadrat size depends on the size of the study area. Usually, a one square meter study area has quadrats of 10 cm square; a 5 square meter area has quadrats of approximately 1 square meter; a 10 square meter area can also have 1 square meter quadrats. A rough map of the study area and the quadrats should be drawn. Number each quadrat on the map. Then randomly pick 15 percent of the quadrats. These quadrats become the areas from which counts will be made. Identify each of the chosen quadrats and count the number of the plants under question in these quadrats. Record the total number of plants counted and divide this number

by the number of chosen quadrats. This will result in the average number of plants per chosen quadrat. Now multiply the average number of plants by the total number of quadrats in the entire study area. This product will be the population estimation for the area. The percent of accuracy can be determined by actually making a direct census of the study plants within the entire area. Density can be determined by using the population estimation and the area of the study plot. Comparisons between plant types can be made by estimating different plant populations. Which plant seems to dominate the area?

POPULATIONS BY TRANSECT

Have your students estimate plant populations by using transects. This activity works best in overgrown areas of the campus such as ditches, and along the edges of the school grounds. Divide the class into small groups of two or three. Each group should make a rough map of the study area by pacing off measurements. Give each group a piece of string that is long enough to stretch across the study area. The string is the transect line and should be securely fastened at both ends. The students should move down the transect line and determine which plant is most numerous within two feet of either side of the string transect. The name of the plant is not important, but, if it can be identified, use the name; otherwise, designate it as plant "A". Record the number of this type of plant along the transect. Do not count grasses. The first transect should be made along one end of the study area. Now move the transect line approximately one-fourth the total distance of the study area from its first position, and repeat the count.

Continue to move the transect line one-fourth the total distance of the study area until four transects have been made. To obtain an estimate of

the total number of the sample plants within the study area, use the following procedure:

1. Determine the total area of the study area;
2. Divide the entire study area by the total area of the transects; (To get the area of one transect, multiply width of 2 feet times length of the transect.)
3. Determine the average number of the study plants in the 4 transects;
4. Multiply the average number of plants in the 4 transects by the answer to step #2. This product is the estimate of the total number of plants within the study area.

How did the different groups compare? How would you determine the second and third most abundant plants?

FISH POPULATION ESTIMATES

If your campus has a pond or shallow canal, have your students determine the population of fish. You will need a seine net, an aquarium, and portable aerators. Seine the shoreline area of the pond. After each seine haul, place the captured fish in a large, well aerated tank. When seine hauls do not produce large numbers of fish, discontinue the capturing. Examine the captured fish in the tank. The different species may be separated. Count each individual, if you wish, to estimate the population of each species; record the data accordingly. Mark each fish by fin clipping or thread marking. (When fin clipping, cut a small "V" shaped notch in the caudal fin. To thread mark, attach a small piece of brightly colored thread to the dorsal fin.)

Return all of the marked individuals back to the pond. Wait one day and then repeat the seining activity. Again place the captured fish in an aquarium. Separate the species, if this was done before. Record the number of new captures and the number of marked fish that were recaptured. To estimate the populations, use the following formula and cross multiply:

Lincoln-Peterson Index:

$$\frac{\text{Population Estimate}}{\text{Total Number of Fish Captured on Day One}} = \frac{\text{Total Number of Fish Captured on Day Two}}{\text{Number of Marked Fish Recaptured}}$$

If you are estimating separate species, then use the data collected for each species in the formula. Which species is most abundant? Try to find information about the natural history of each species. Why is one species more abundant than others? What problems can you see with this estimating technique?

SMALL MAMMAL SCAT BOARD POPULATION STUDY

If your school borders a woodland or a plant community that is distinctly different from the campus grounds, this activity can be used to determine animal movements from one community into another. Place a series of scat boards (a 6 to 12 inch square of plywood or tile used to observe animal droppings) throughout the two communities. The boards should be placed on transects that travel through both communities. Place the boards equi-distant from each other to get a more accurate (understanding) picture of animal movement. Set out bait pans in each community on the transect lines. The bait pans should be placed approximately five meters inside each community of these transect lines. Obtain a small amount of the vital stains, Congo Red and Fast Green. Each community will be represented by a different dye. Mix approximately 3-5 grams of Congo Red with 1 pound of rolled oats and peanut butter bait. Mix the same proportions of rolled oats and peanut butter with the Fast Green dye. The amounts of bait can be increased or decreased according to the size of the study area. Set the scat boards and baited pans along the transect lines after school. Collect the scat from the boards after a 24 hour period. To determine where the animal ate its food, mix the scat

with water. The dye color will appear. How far do animals from one community penetrate into another? What implications does this have in competition for food? Did any animals feed in both areas?

ESTIMATING ANIMAL POPULATIONS: LINCOLN-PETERSON INDEX

Take your class outdoors and divide into small groups. Have each group mark off a one square meter area. Divide this area into 16 squares, 25cm x 25cm. Give each group 200 small objects such as toothpicks, lima beans, peas, pebbles, grains of corn, etc., and a marking pen or crayon. Spread the objects evenly throughout the square meter. Students should now pick out 10% of the smaller squares from which to sample. The choices can be made by picking numbers from a hat. Place numbered pieces of paper in a container, each piece of paper representing one 25cm x 25cm square. Place the chosen pieces of paper in their appropriate squares or the ground Now one student should "capture" as many of the "animals" (small objects) as possible from the chosen squares during a one minute time period. Record this number as Capture One. Mark each of the capture objects with the crayon or pen. Now evenly redistribute the marked animals throughout the entire meter area. Next, re-pick 10% of the smaller squares and place the small pieces of paper into their appropriate squares. Again carry out the one minute capture technique. Record the number of "animals" captured as Capture Two; also, separately record the number of marked animals in Capture Two as ReCaptures. Now place the data into the following formula and cross multiply to get an estimate of the total population:

$$\frac{\text{Population Estimate}}{\text{Capture One Total}} = \frac{\text{Capture Two Total}}{\text{ReCaptures}}$$

Students can then count the total number of animals in the meter and determine the percentage of error.

POPULATION DENSITY

Divide the number of people in your classroom by the number of square feet

available. The result will be your classroom population density. (People ÷ sq. fit. of classroom = population density per square foot of the classroom). Now have students determine, by pacing the dimensions of your school grounds. Find the school population and compute the density of students per sq. ft. of ground. What would be the density of students per acre?

In the classroom, have students compute the present population density of Pinellas County (Population 1979: 791,160) (a) people per sq. mi., (b) people per square acre. Compute what this density will be 10 years from now.

AQUATIC PRODUCTIVITY

The primary productivity of an aquatic community is the rate at which energy from the environment is converted into organic compounds by photosynthetic organisms. One method to determine the primary productivity is to measure the oxygen output of the producers. To test for productivity you will need either a commercial dissolved oxygen test kit (Hack or La Motte) or the Winkler materials and apparatus. Take a water sample from the desired location. Test this sample for dissolved oxygen content. Record the results and oxygen content at the start. Next, take two more samples from the same location. Cover one of the sample bottles with aluminum foil so that light cannot penetrate into the bottle. Be certain that both sample bottles are sealed tightly. Suspend the bottles in the pond at the depth from which the samples were taken, for 1 to 24 hours. Remove the bottles and test for oxygen content. Record the results for the bottle kept in the dark by the aluminum foil, and the results from the bottle left in the light. To determine the respiration of this section of the pond:

Respiration = Oxygen content at start minus oxygen content of dark (Oxygen consumed) bottle at end of exercise.

Now calculate the Gross Primary Production by using the following formula:

Gross Primary Production (Total oxygen produced) = Oxygen content of uncovered bottle at end of exercise minus oxygen content of dark bottle at end of exercise.

Next, calculate the Net Primary Productivity as follows:

Net Primary Productivity (Total oxygen left in system after respiration) = Gross Primary Productivity minus Respiration value

These values (Respiration, Gross and Net Primary Productivity) may be converted from ppm or mg/liter of oxygen to milligrams of carbon per cubic meter by multiplying each value by 375.36 Do different areas of the pond vary? Do different depths vary?

LEAF UTILIZATION

Green plants produce food by photosynthesis. The food energy stored in the leaves is passed to the next trophic group, the first order consumers, when the leaves are eaten. Have your students calculate the leaf utilization by first order consumers on different parts of the school campus. Mark off a 5 to 10 square meter area. Identify each major species of plant in the study area. Take 25 living leaves that show signs of being eaten from each species. Look for holes and chewed edges on the leaves. Estimate the percent of each of the leaves that has been eaten away. One way of doing this is by tracing the leave on graph paper and then estimating the percent that was eaten. Obtain an average for the 25 leaves for each species sampled. This figure is the insect utilization of the plant species. To calculate utilization of the plant materials net productivity, multiply the percent of insect utilization by .27. (The figure, .27, was obtained by scientists working with forest productivity. It was found that the average production of a forest's energy that ended up as leaf material was 27% of the total energy of production.) How do different species of plants compare in their utilization? Do you think these

figures would change during different seasons? How does the total utilization for your study area compare with other areas on campus? Can you think of reasons for these differences? (To obtain total utilization of net productivity, add the percent utilization for each species in your study area and multiply by .27.)

CHEMICAL PARAMETERS AND DIATOMS

Select a canal or pond on or near the school grounds and have your class monitor the area for an increase in diatom populations. Once every other day, students should determine the concentrations of phosphates and/or nitrates. Hach or LaMotte test kits should be used for these determinations. A two liter sample of water should also be collected for each chemical sampling day. The chemical data should be recorded and placed in graphic form. The two liter water samples should be passed through a Millipore filter apparatus with an .8 gridded filter. Remove the filter and cut out one of the 4mm x 4mm squares. Carefully place this section of the filter on a microscope slide. Place one or two drops of cedar wood oil on the grid section and cover with a cover slip. The cedar wood oil changes the refractive index of the filter so that the filter cannot be seen. Count the number of diatoms on the filter square. Multiply the number by 108.44 to obtain an estimate of the total number of diatoms in the 2 liter sample. Place this data in a graph. This activity works best after a heavy rain since nutrient runoff usually adds nitrates and phosphates to the water. Was there a population change as the phosphate and/or nitrate levels increased? Why?

PLANTS AND STUDY PLOTS

A simple activity involves students locating their own study plot of ground one foot square. Space out students and be certain that every range of campus plant communities is represented. Students work in pairs. Each pair places a one foot square string or block over their section of ground.

Students on hands and knees count all the different kinds (species) of plants. within their plot. (2,5,10,etc.) There is no attention paid to identification, only the number of different plants. (Densities can also be figured, the number of each species per sq. ft.) Compose a map, color or symbol-coded, of the grounds demonstrating the various densities of plant species around the school grounds.

MINI-DESERT

Find an area on campus that is covered with some type of paving material; parking lot or streets work well. Divide the class into small study groups. Give each group a thermometer and a piece of cardboard. Also bring along a couple of hammers and some large spikes. The spikes should be at least 6 inches long and make a hole big enough for a thermometer to fit into. Students should record temperatures within a half inch of the "desert" floor during full sunlight. Next shade the area for a few minutes and record the shade temperature. Make a hole in the "desert" floor with spike and record the below ground temperature in full sunlight. Repeat this part of the exercise after shading the area. If possible, make temperature records of the same areas at night. Look for evidence of flash floods on the "desert" (leaves and dirt pushed into ridges or small piles). Repeat the entire exercise in other desert-like areas on campus. How do these areas compare to a grassy lawn or an area under shrubs or trees? Where do you think animals would live on your "desert?" Would the animals be more likely to hunt at night or during the day? Can your desert support any plant life?

AUTOMOBILE AND YOUR CAMPUS

Determine the percentage of the school campus that is used by automobiles. Have students determine the total area of the school campus by first measuring their pace and then pacing off the perimeter of the campus. Next they should determine the areas of parking lots and roads on the campus plus any driver education areas. Look for evidence of recent changes taking place on campus to accommodate cars. Is the influence of cars increasing or decreasing on the campus?

CAMPUS NOISE

Have your students make five minute recordings with portable tape recorders from different areas of the campus. The sound level should be set the same at each location. Try to get recordings during different times of the day. Plot the locations on a campus map. Have the class identify the sounds they hear. Are any areas of campus noisier then other areas? What can be done about the noise in each area? Do the noise levels change during different times of the day? Why? How can shrubs and trees help in softening noise levels?

NOISE LEVELS

Use the walk-away test to determine the overall noise condition of your school. Divide your class into pairs and give each pair a test book and a data sheet. The data sheet should have the following information: Names in group; time of day; location on campus; noise level from noise chart. To use the walk-away test, one student stands at a fixed location while the other student, starting at a distance of two feet, backs slowly away. The student standing at the fixed location should read from the text in a normal speaking voice. It is important that the speaker not raise his voice in order to maintain communication. When the person walking away can only understand a scattered word or two in a 10 second period, the listener should stop backing away. Measure the distance between the speaker and listener and compare the distance to the chart below:

Noise Level	Distance Where Understanding Becomes Very Difficult	Noise Acceptability Level
#1	More than 70 feet	Very Acceptable
#2	2 - 70 feet	Acceptable
#3	7 - 25 feet	Not very acceptable
#4	Less than 7 feet	Unacceptable

SOIL PARTICLE SIZE

Divide your class into small groups. Give each group a quart jar approximately three-fourths full of water. Assign each group a different area of the campus to sample for soil particle size. Students should collect 4 tablespoons of soil from their sampling site. Place the soil in the jar of water and shake vigorously and then allow the particles to settle. It may take overnight to get complete settling (¼ teaspoon of alum and a teaspoon of household ammonia will speed up the process). Measure each layer and calculate the percent each layer is of the whole. Compare soils from different areas of the campus. Why do some areas differ?

RECORDING TEMPERATURES

Let students stand in the bright sunlight so their shadows are behind them and hold a thermometer in the light until the fluid stops moving. Note the temperature. Then have them turn in the opposite direction and hold the thermometer in the same position in their shadow. Wait for a change in temperature reading. Objects that block the sun shut off heat waves as well as light waves.

WIND ON THE CAMPUS

Determine the wind directions and wind effects on campus. Send students to areas throughout the campus. Try to include all parts of the campus such as near corners of buildings, breezeways, near trees and shrubs, parking lots, etc. Use pieces of light yarn or ribbon to determine wind directions. Draw a map of the school grounds on the chalkboard and indicate wind directions with arrows. Ask students to look for indicators that show which way the wind blows (piles of sand; litter in one area; trees bent in one direction, etc.). Could the school campus be designed to take advantage of wind directions; if so, how?

WHERE DO THE INSECTS LIVE?

Obtain several sheets of fly paper or paint a mixture of fermented fruit and molasses on cardboard sheets. The students should choose as many different areas on campus as possible to place their sticky traps. Whenever possible, one trap should be placed directly on the ground and another trap several feet above the ground. Were more insects caught under trees, in the open, in weed areas, etc.? If possible, place the sheets outdoors on sunny days and then again on moist overcast days. Also compare night captures to daytime captures.